World Trade Center Response Activities
Close-Out Report

September 11, 2001–April 30, 2003

Prepared by

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Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation

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Background/Purpose

At approximately 8:45 AM Eastern Daylight Time on Tuesday, September 11, 2001, a commercial airplane crashed into the north tower of the World Trade Center complex in New York City. Initially, the severity of the incident, the numbers of people involved, and the reason for the crash were all unknown. Shortly after 9:00 AM, a second plane hit the south tower of the World Trade Center. The south tower of the World Trade Center collapsed, followed within 30 minutes by the north tower. Reports indicated that at approximately 5:30 PM a third tower in the World Trade Center complex, Building Number 7, also collapsed. Wednesday evening, September 12, another building within the World Trade Center Complex collapsed.

The collapse of these structures, particularly the north and south towers, released massive amounts of dust and debris that covered lower Manhattan. Residents were evacuated from many areas south of Canal Street.

Almost immediately after the planes crashed into the World Trade Center Towers, the Division of Toxicology (DT) of the Agency for Toxic Substances and Disease Registry (ATSDR) implemented emergency response procedures (e.g., the ATSDR emergency coordination center was manned 24 hours a day). In addition, ATSDR's Division of Health Assessment and Consultation (DHAC) staff was placed on alert to help with the response to the terrorist attack.

On September 14, 2001, the DT Emergency Response Section contacted DHAC and indicated that the amount of environmental data and information that would be generated by the U.S Environmental Protection Agency (EPA) and others would require a long-term (e.g., months) commitment by ATSDR. General ATSDR operating procedures dictate that DT responds to short-term emergency response activities and DHAC is responsible for long-term public health response activities. With the request from DT, the day-to-day management of the ATSDR World Trade Center response was transferred from DT to DHAC. This Close-Out Report summarizes the public health activities that DHAC conducted to assist New York City in their World Trade Center recovery efforts.

On-Site Support

On September 16, 2001, to better facilitate communications and the exchange of sampling data between EPA Region II and ATSDR Atlanta, DHAC sent a technical staff person to the EPA Region II Edison, New Jersey, Office. On September 22, 2001, he was replaced with a different technical staff person. Then, on September 26, 2001, deployment of DHAC technical staff to the EPA Edison Office ended because ATSDR Office of Regional Operations (ORO) was able to provide additional support to the ATSDR Region II office.

On September 26, 2001, the New York City Department of Health and Mental Hygiene (NYC DOHMH) requested ATSDR's assistance. Specifically, NYC DOHMH requested that ATSDR provide on-site technical support to interpret the environmental monitoring data collected, assist with developing public health informational/educational material, and assist in providing technical information to the New York City public during public meetings. This request was

routed through the appropriate federal response coordination functions and was tasked to ATSDR by the Federal Emergency Management Agency (FEMA), which provided funding to cover the travel expenses of the ATSDR technical staff deployed to NYC DOHMH. Because part of the mission was to assist in the development of health educational material, the ATSDR Division of Health Education and Promotion (DHEP) technical staff became part of the response team. The on-site technical support to NYC DOHMH continued through June 28, 2002. Appendix A contains a list of the ATSDR staff that participated in the on-site technical support and dates of their deployments either to the EPA Region II, Edison, New Jersey, Office or NYC DOHMH.

The major public health action that the on-site ATSDR technical staff helped NYC DOHMH with was to implement the *Ambient and Indoor Sampling for Public Health Evaluations of Residential Areas Near the World Trade Center* (1). The overall objective of the sampling effort was to provide results upon which public health agencies can further determine the potential for environmental exposures to World Trade Center collapse-related materials and possible health implications of the exposures. Sampling characterized ambient and indoor airborne and potentially airborne particles (surface dust) in residential areas of lower Manhattan from the collapse of the World Trade Center. Sampling of residential units occurred from November 4 through December 11, 2001, and was conducted by U.S. Public Health Service commissioned officers detailed to NYC DOHMH with ATSDR on-site technical staff doing the project coordination (e.g., helping recruit building owners and residents to participate in the investigation, providing logistical support to the sampling team, and assuring coordination with ATSDR Atlanta staff and the sampling team). The final report for this investigation was provided to the public on October 4, 2002 (2).

The ATSDR staff deployed to NYC DOHMH also prepared technical briefing papers on various issues that were used to prepare for community outreach activities and assist NYC DOHMH in responding to press inquiries. Appendix B contains examples of these technical briefing papers, which were frequently co-developed by the Atlanta-based ATSDR World Trade Center Response Team (see discussion under "Reach Back Support").

Reach Back Support

With the transfer of the day-to-day World Trade Center response operations from DT to DHAC, a team of DHAC technical staff was formed. The team was responsible for reviewing and evaluating the environmental monitoring data, determining what public health actions are needed to address the needs of New York City, and providing technical and logistical support to the ATSDR technical staff deployed to NYC DOHMH. During the first 4 weeks after the attack, DHAC staff provided 24-hour, 7-day-a-week coverage (Appendix C contains a list of the team members and the duty roster for that time period). The technical staff's interpretation of data was provided verbally to EPA Region II and other federal, state, and local governmental agencies during conference calls that NYC DOHMH conducted (daily 7-days-a-week call from September 13 through October 5, 2001; daily working day calls from October 5 through October 31, 2001; and weekly calls from November 1 through December 31, 2001). The

complete team met every working day (Monday through Friday) from 9:00–10:00 AM to discuss technical issues and to assure appropriate coordination of activities.

On October 8, 2001, 24-hour coverage was discontinued. The decision to discontinue 24-hour coverage was based upon ambient monitoring data that indicated that the levels of contaminants from the World Trade Center had reduced to a point that it was not necessary for ATSDR to provide intensive technical staff coverage. In addition, the number of ATSDR Atlanta staff assigned to the World Trade Center response was adjusted as outlined in the plan contained in Appendix D.

It was the members of the adjusted ATSDR World Trade Center Response Team that developed the sampling plan used during the *Ambient and Indoor Sampling for Public Health Evaluations of Residential Areas Near the World Trade Center* (1). This team provided the necessary data interpretation and were the primary authors of the *Final Technical Report of the Public Health Investigation To Assess Potential Exposures to Airborne and Settled Surface Dust in Residential Areas of Lower Manhattan* (2). This sampling effort was the first to characterize indoor conditions in lower Manhattan residences. The final report was released to the public on October 4, 2002.

One of the major logistical support activities that the ATSDR World Trade Center Response Team provided NYC DOHMH and the ATSDR technical staff deployed to NYC DOHMH was the plotting and generation of geographic information system (GIS) maps. These maps depicted the various monitoring locations and the results of the air-monitoring program around the World Trade Center. These GIS maps were used during community meetings that NYC DOHMH conducted with the deployed ATSDR technical staff. In addition, the ATSDR World Trade Center Response Team provided NYC DOHMH with various draft fact sheets and technical briefing papers. For example, draft fact sheets were provided that discussed asbestos and the NYC DOHMH/ATSDR residential sampling investigation and a draft technical briefing paper was provided on particulate matter (see Appendix E). NYC DOHMH and the deployed ATSDR technical staff used these documents and others to prepare for the various community meetings.

Besides providing direct technical support to NYC DOHMH, DHAC participated in the federal Environmental Assessment Working Group. Officially, formed on September 15, 2001, the work group was co-chaired by the Department of Health and Human Services (DHHS), EPA, and the Department of Labor. The director of DHAC was the DHHS chair to the work group. The purpose of the group was to coordinate public health and occupational sampling and data review among the three federal agencies in support of the New York City Department of Health and the New York State Department of Health. The group met via conference calls (daily 7-days-a-week call from September 13 through October 5, 2001; daily working day calls from October 5 through December 31, 2001; and then a weekly to monthly call from January 1 through October 15, 2002). The Environmental Assessment Working Group's primary accomplishments are the following:

- reviewed and implemented monitoring plans,
- reviewed and interpreted sampling results,

- archived environmental samples,
- establishing airborne asbestos action levels (see Appendix F), and
- establishing and maintaining a centralized database of all environmental sampling results.

The activities of the federal Environmental Assessment Working Group led to the ATSDR/NYC DOHMH proposal to develop and maintain the World Trade Center Exposure Registry. FEMA has provided funding so that the World Trade Center Exposure Registry can be developed. The Registry will track the health of participants to determine if their exposures to smoke, dust, and airborne substances around the WTC site may have short- or long-term impacts on their physical health. Additionally, the registry will track the mental health of the 100,000–200,000 persons anticipated to be enrolled in the registry.

The federal Environmental Assessment Working Group was also instrumental in the formation of the EPA Region II Task Force on Indoor Air in Lower Manhattan and the New York City Lower Manhattan Air Task Force. Both of these task forces are discussed in more detail below.

On February 2, 2002, EPA Region II formed the Task Force on Indoor Air in Lower Manhattan. The ATSDR World Trade Center Response Team was specifically asked to participate on this Task Force. The Task Force and its associated Working Group were responsible for providing technical consultation to EPA Region II on how best EPA Region II should respond to the indoor air issues related to the collapse of the World Trade Center towers. The following major projects were undertaken as a result of the task force's efforts:

- sampling investigation to better define the typical New York City background levels of various World Trade Center related materials (e.g., asbestos, fibrous glass, and crystalline silica);
- demonstration project that evaluated the various cleaning techniques that could be used to remove World Trade Center related materials from residential areas (e.g., HEPA vacuum);
- selection of chemicals of potential concern (COPC) to be addressed in indoor areas and development of air and surface screening values to employ as samples were collected;
- cleaning of the exterior of all lower Manhattan buildings;
- coordinating the interior cleaning of the few abandoned buildings in lower Manhattan;
- establishing a voluntary cleaning and/or sampling program of lower Manhattan residential units.

The ATSDR World Trade Center Response Team reviewed the various technical documents that were generated to conduct the projects. In addition, team members were contributing authors to the COPC selection document (3) and helped EPA Region II address comments received from an external peer-review panel.

The EPA Task Force on Indoor Air in Lower Manhattan was still active when this close-out report was issued. ATSDR will continue to be an active member of the EPA Task Force until the various task force projects are completed. Interagency agreements have been signed between EPA Region II and ATSDR to provide for the continued involvement of ATSDR. It is

anticipated that the EPA Task Force will complete all of its activities by the end of the 2003 summer.

In addition to the EPA Task Force on Indoor Air in Lower Manhattan, the ATSDR World Trade Center Response Team was an active member of the New York City Lower Manhattan Air Task Force. Mayor Michael R. Bloomberg formed the city task force on March 8, 2002. The task force was charged by the mayor to coordinate the response of the city agencies and to establish a complaint and information phone line about environmental issues in and around the World Trade Center. The City Task Force held weekly coordination meetings until June 5, 2002.

Policy and Guidance Development

In addition to being the driving force of the NYC DOHMH/ATSDR *Ambient and Indoor Sampling for Public Health Evaluations of Residential Areas Near the World Trade Center*, the ATSDR World Trade Center Response Team developed the tiered approach and provided technical support for the development of the airborne asbestos action levels coordinated by the federal Environmental Assessment Working Group (Appendix F). The team also assisted EPA Region II in developing draft World Trade Center health effects screening criteria (see Appendix G). Those draft screening criteria were superceded by the *World Trade Center Indoor Air Assessment: Selecting Contaminants of Potential Concern and Setting Health-Based Benchmarks* (3). ATSDR staff was actively involved in the Contaminants of Potential Concern document, key in the development of a tiered approach to screening sampling results, and wrote portions of the EPA peer-reviewed report. ATSDR team members are listed as contributors to that document. In addition, a team member is also listed as a contributor to the EPA report entitled - *Exposure and Human Health Evaluation of Airborne Pollution from the World Trade Center Disaster* (4).

Strengthening the Science Base

One of the public health issues highlighted by the public was the need to further explore the potential for health effects from exposure to biopersistent fibers, specifically asbestos and some synthetic vitreous fibers (SVF). Additionally, there are potential concerns surrounding smaller-length fibers that may have been generated by each of these past activities, especially in relation to the materials found in lower Manhattan. To help respond to these issues, the ATSDR World Trade Center Response Team requested ATSDR's Division of Toxicology (DT) to develop a "white paper" on the *Health Effects from Exposure to Fibrous Glass, Rock Wool, or Slag Wool*. That white paper was finalized on June 14, 2002 (5). ATSDR issued the *Toxicological Profile for Synthetic Vitreous Fibers*, which is based in part upon the white paper (6).

Smaller fibers and nonfibrous particles that might be generated as fibrous materials can be processed, disposed of, or damaged, as in the case of the World Trade Center tower collapse. In these situations, traditional fiber-counting techniques might not quantify all of the materials present. Standard assessment methodology addresses fibers greater than 5 microns in length, on the basis of the relative risk of longer fibers being greater than that of shorter fibers. Significant toxicology and occupational health research has focused on asbestos fibers and SVF greater than

5 microns in length; however, it seems that much less is known about the potential health effects of smaller fibers. The ATSDR World Trade Center Response Team identified a need to understand the potential for fibers less than 5 microns in length to contribute to adverse health effects. This resulted in ATSDR convening an expert panel to gain a greater understanding of asbestos and SVF toxicity, especially as it relates to fibers less than 5 microns in length. The expert panel met in New York City on October 29 and 30, 2002. The discussions, findings, and recommendations of the panelists' are presented in the *Report on the Expert Panel on Health Effects of Asbestos and Synthetic Vitreous Fibers: The Influence of Fiber Length* (7). The three major findings of the panel are:

- Health effects from asbestos and SVFs ultimately are functions of fiber dose, fiber dimension (length and diameter), and fiber durability (as determined by the mineral type, the amorphous or crystalline structure, and the surface chemistry).

- Based on findings from epidemiologic studies, laboratory animal studies, and *in vitro* genotoxicity studies, combined with the lung's ability to clear short fibers, the panelists agreed that there is a strong weight of evidence that asbestos and SVFs shorter than 5 microns do not cause cancer in humans.

- With one exception, the epidemiologic studies, laboratory animal studies, and *in vitro* studies generally suggest that asbestos and SVF pathogenicity increases with fiber length. At sufficiently high doses, asbestos and SVF have been shown to cause inflammation, pulmonary interstitial fibrosis, and pleural reactions in laboratory animals; but the doses needed to cause these effects in humans may not be relevant to environmental exposures. As the exception, some epidemiologic studies involving highly exposed workers found that pulmonary interstitial fibrosis is correlated with the amount of *short fibers* in the lung at death, but this apparent association might be explained by long fibers breaking down into shorter fibers between exposure and the time that lung samples were collected.

As of this close-out report, the ATSDR World Trade Center Response Team has conducted professional presentations concerning ATSDR response activities at the World Trade Center at the following technical conferences:

- Theories and Practices in Toxicology and Risk Assessment, Cincinnati April 15–18, 2002.

- 2002 Public Health Professional Conference, Commissioned Officers Association of the U.S. Public Health Service, Atlanta, April 21–26, 2002 (four separate presentations).

- National Environmental Health Association 2002 Chemical and Bioterrorism Conference, Minneapolis, June 30–July 3, 2002.

- 75th Water Environment Federation Annual Technical Exhibition and Conference, Chicago, September 28–October 2, 2002.

The ATSDR World Trade Center Response Team, as appropriate, will conduct other presentations at professional conferences.

In addition to professional presentations, the team also developed a publication that appeared in the *Morbidity and Mortality Weekly Report* (8) concerning the results of the *Final Technical Report of the Public Health Investigation To Assess Potential Exposures to Airborne and Settled Surface Dust in Residential Areas of Lower Manhattan.* Additional publications may also be developed by the team.

References

1. New York City Department of Health and Mental Hygiene and Agency for Toxic Substances and Disease Registry. Ambient and indoor sampling for public health evaluations of residential areas near World Trade Center, New York, New York: sampling protocol. Atlanta: US Department of Health and Human Services; 2001.

2. New York City Department of Health and Mental Hygiene and Agency for Toxic Substances and Disease Registry. Final technical report of the public health investigation to assess potential exposures to airborne and settled surface dust in residential areas of Lower Manhattan. Atlanta: US Department of Health and Human Services; 2002.

3. US Environmental Protection Agency Region II. World Trade Center indoor air assessment: selecting contaminants of potential concern and setting health-based benchmarks. New York: US Environmental Protection Agency Region II; 2002.

4. National Center for Environmental Assessment. Exposure and human health evaluation of airborne pollution from the World Trade Center Disaster. Washington, DC: US Environmental Protection Agency, National Center for Environmental Assessment; 2002.

5. Agency for Toxic Substances and Disease Registry. Technical briefing paper: health effects from exposure to fibrous glass, rock wool, or slag wool. Atlanta: US Department of Health and Human Services; 2002.

6. Agency for Toxic Substances and Disease Registry. Toxicological profile for synthetic vitreous fibers. Atlanta: US Department of Health and Human Services; 2002.

7. Agency for Toxic Substances and Disease Registry. Report on the Expert Panel on health Effects of Asbestos and Synthetic Vitreous Fibers: The Influence of Fiber Length. Atlanta: US Department of Health and Human Services; 2003.

8. Jeffery NL, D'Andrea C, Leighton J, Rodenbeck SE, Wilder L, DeVoney D, et al. Potential Exposures to Airborne and Settled Surface Dust in Residential Areas of Lower Manhattan Following the Collapse of the World Trade Center---New York City, November 4---December 11, 2001. Morbidity and Mortality Weekly Report. 2003;52(07):131-6.

Appendices

Appendix A—Agency for Toxic Substances and Disease Registry Technical Staff Deployed to Either the Environmental Protection Agency Region II Edison, New Jersey, Office or New York City Department of Health and Mental Hygiene To Assist with World Trade Center Recovery Efforts

Agency for Toxic Substances and Disease Registry Technical Staff Deployed to Either the Environmental Protection Agency Region II Edison, New Jersey, Office or the New York City Department of Health and Mental Hygiene to Assist with World Trade Center Recovery Efforts

Name	Division	Start Date	End Date	Deployed To
Gregory Zarus, MS	DHAC	9/16/2001	9/22/2001	EPA II
LCDR Tim Walker, MPH, RS, CIH	DHAC	9/28/2001	10/26/2001	EPA II & NYC DOHMH
CAPT Robert Johnson, MD	DHAC	10/3/2001	11/7/2001	NYC DOHMH
CAPT Ralph O'Connor, Jr., PhD	DHEP	11/4/2001	12/5/2001	NYC DOHMH
CDR Stephen Blackwell, RS, MPH	DHEP	12/2/2001	12/21/2001	NYC DOHMH
CDR Joe Maloney, REHS, MPH	DHEP	12/9/2001	12/21/2001	NYC DOHMH
CDR Richard Sullivan, REHS	DHEP	12/9/2001	12/21/2001	NYC DOHMH
Yolanda Freeman, BS	DHEP	1/2/2002	1/7/2002	NYC DOHMH
CAPT Ralph O'Connor, Jr., PhD	DHEP	1/6/2002	1/10/2002	NYC DOHMH
CDR Mark Miller, RS, MPH	DHEP	1/6/2002	1/30/2002	NYC DOHMH
LCDR Ketna Mistry, MD	DHAC	1/6/2002	1/30/2002	NYC DOHMH
Barbara Cooper, MSPH	DHAC	1/27/2002	2/13/2002	NYC DOHMH
John Crellin, PhD	DHAC	2/10/2002	2/27/2002	NYC DOHMH
LT Steve Dearwent, MPH	DHAC	2/24/2002	3/13/2002	NYC DOHMH
Christine Rosheim, DDS, MPH	DHEP	2/14/2002	3/1/2002	NYC DOHMH
Diane Drew, RN, MPA	DHEP	3/3/2002	3/15/2002	NYC DOHMH
LCDR Clem Welsh, PhD, MPH	DHAC	3/10/2002	3/27/2002	NYC DOHMH
Donna Orti, MS, MPH	DHEP	3/17/2002	3/29/2002	NYC DOHMH
David Fowler, PhD	DHAC	3/24/2002	3/29/2002	NYC DOHMH
Azania Heyward-James, MEd	DHEP	3/13/2002	4/12/2002	NYC DOHMH
Barbara Cooper, MSPH	DHAC	3/31/2002	4/9/2002	NYC DOHMH
LCDR Robert Knowles, MS, REHS	DHAC	4/7/2002	4/19/2002	NYC DOHMH
Annmarie DePasquale, MPH	DHAC	4/21/2002	5/8/2002	NYC DOHMH
Dinayi Yu, MD	DHEP	5/5/2002	5/10/2002	NYC DOHMH
LT Steven Dearwent, MPH	DHAC	5/5/2002	5/22/2002	NYC DOHMH
CDR Steve Inserra, MPH, RS	DHS	5/12/2002	5/24/2002	NYC DOHMH
LT Tarah Somers	DHAC	5/19/2002	6/2/2002	NYC DOHMH
Grant Baldwin, MPH, CHES	DHEP	5/26/2002	6/7/2002	NYC DOHMH
Debra Gable, MS	DHAC	6/2/2002	6/28/2002	NYC DOHMH

DHAC – Division of Health Assessment and Consultation
DHEP – Division of Health Education and Promotion
DHS – Division of Health Studies
EPA II – U.S. Environmental Protection Agency Region II, Edison, New Jersey
NYC DOHMH – New York City Department of Health and Mental Hygiene

Appendix B – Examples of Technical Briefing Papers Developed by Agency for Toxic Substances and Disease Registry Technical Staff Deployed to the New York City Department of Health and Mental Hygiene

MAIN MESSAGES for WORLD TRADE CENTER DISASTER

1. General population

Many healthy people have experienced symptoms of coughing, eye, nose, and throat irritation, wheezing, difficulty breathing and skin irritation after exposure to dust from the Sept. 11th World Trade Center (WTC) attack. As dust and fires have decreased in the environment, air quality has improved over the last 3 months. There will be times when dust loads may be higher, because of demolition activities. As the dust levels slowly decrease, these symptoms should slowly improve for most exposed people.

2. Long-term health effects from dust exposures

One of the contaminants in the dust that community members are concerned about is asbestos. On the basis of available air sampling information, the risk for disease from asbestos exposure in the community near the WTC is very low. Most of the information on asbestos is based on studies of workers who were exposed to asbestos in their job [for example, brake manufacturers, asbestos insulation].

Most workplace exposures often involve very high levels of asbestos over many decades. These two factors often lead to a high risk of asbestos-related disease after many decades in some workers. So, a short-term exposure to asbestos (such as 3--4months) at relatively low intermittent levels has a low risk of developing asbestos-related disease.

3. Regulations/standards

A screening level does not mean it will cause illness/disease if it is exceeded. Instead, a screening level is a signal for regulatory agencies to "pay attention" to the chemical and monitor it more closely. In general, standards/regulations are set to protect health; they also take into account sensitive populations, such as children and the elderly. Different standards/regulations are used for different situations. For example, a standard for drinking water is based on people drinking water for many years on a daily basis. A standard for air is based on people in the environment inhaling the air every day years. There are standards for work environments. These are based on 8 hours a day, 40 hours a week exposure for many years where chemical levels are generally higher than the general public will be exposed to in the environment.

4. Intense dust exposure

In general, the higher the amount of dust a person breathes in, the more likely that a person's health may be affected. Some people who had intense dust exposure in the first few days might experience asthma for the first time if they inhaled a large amount of dust, such as some rescue workers. Those that develop asthma or respiratory problems for the first time may improve with time and others might continue to have asthma or respiratory-related problems.

5. Sensitive populations

Some people with pre-existing conditions such as asthma, allergies, chronic smokers, and other respiratory and heart conditions are likely to have more severe and frequent symptoms initially. As the dust levels decrease, these symptoms should slowly improve in most people, while in a small number of people these symptoms might persist.

6. Elderly and children

Children and the elderly are generally more vulnerable to most health hazards. Avoidance of areas that still have a lot of dust is beneficial.

•Children inhale more frequently and breath more air than adults,
•They breathe closer to the ground where dust is closer, and
•They are generally more physically active. As their activity level increases, so does the amount of air and dust made airborne that they inhale.

Air quality may be poorer than normal throughout lower Manhattan near the cleanup of the WTC. Under these conditions, children may experience more wheezing, coughing, dry and sore throats than usual, even if air quality levels are within federal guidelines.

Children that crawl and put fingers and objects into their mouths may be exposed to greater levels of dust and its contaminants than other children. Children who are very active on days with poor air quality or in areas with accumulated dust might have increased exposure. Even still, it is important to allow children to continue to play and be active, for both physical and emotional well-being. To minimize exposure, these recommendations should be followed:

•Reducing outdoor physical activity on particularly dusty or smoggy days,
•Removing shoes before entering the home,
•More frequent washing of clothing,
•More frequent hand, face, and hair washing, and
•If older children wear contacts, they should wear glasses.

7. Protective measures to limit dust exposure

Because dust might still be present after initial cleaning, it is still important to regularly follow these guidelines to avoid continued dust exposure:

• Clean more frequently than normal to minimize dust accumulation and dust levels in air, especially if you have children.
• Continue cleaning in your home with a wet cloth/mop.
• Do not dry sweep or dust, which will spread the dust around and into the air.
• Dusty clothes should be laundered by a washing machine, separately from clothes that are not dusty.
• A regular vacuum cleaner, without HEPA filters, is not recommended because this will spread the dust into the air.

- Avoid tracking in dirt (remove shoes at door) and have a floor mat outside your door.
- Use a HEPA vacuum (they can be rented) to clean dust (HEPA = High Efficiency Particulate Air Filter).
- Change air filters in your air-conditioner and other ventilation systems frequently.
- Run the air-conditioner on "recirculate" with vents closed.
- Keep windows closed.
- The use of N-95 disposable paper masks, which are available in local hardware stores, might offer some relief from nuisance dust and smoke when walking outdoors.
- Rinse cups, pots, pans, and kitchen utensils before use when you think the air might have been dusty.

The bottom line should be a prudent avoidance of exposure to dust and fumes.

8. Contents of Dust/Smoke

The dust and smoke released in the WTC disaster include some of the following:

- concrete (high pH and it is very irritating)
- burning of metals, glass, wood, and other construction materials
- some asbestos, used in the WTC for insulation and fireproofing
- silica
- plastics
- fiberglass dust
- mica
- gypsum

Many of these substances are very irritating to the eyes, nose, throat, lungs, and sometimes to the skin.

9. Mixtures and individual chemicals

We do know a lot about individual chemicals and their effects. Different chemicals affect different parts of the body. For example, asbestos affects the lungs, benzene affects the blood-forming elements, and lead causes learning problems.

Research on combined or mixtures of chemicals is still very sparse. Therefore, little is known. Exposure to multiple chemicals that affect the same organ, such as the lungs, can have an additive effect on that organ. For example, we do know that smoking and asbestos exposure can combine together to increase a person's risk for lung cancer, much more than just exposure to asbestos alone.

10. Fiberglass exposure

Fiberglass is an irritant. Acute exposure to fiberglass can cause eye irritation, nose bleeds, runny nose or nose congestion, sore throat, coughing, skin irritation, and in some cases bronchitis.

Long-term exposures to fiberglass (seen in workers) have led to increased episodes of bronchitis. There is limited evidence that fibrous glass implanted into animal lungs causes cancer. There is no consistent evidence that fiberglass causes cancer in humans.

Methods to reduce irritation from fiberglass include all the recommendations in exposure prevention. In addition; avoid contact lenses in areas of a lot of dust, and wash eyes with saline and water. A humidifier also might help with the irritating symptoms. Long-sleeve shirts will protect skin from irritation.

MESSAGES FOR PCBs

1. Polychlorinated biphenyls (PCBs) are produced from the WTC from burning of electrical devices containing PCB capacitors, old hydraulic oils, and old fluorescent lighting fixtures.

   PCB manufacturing halted in 1977, but equipment in the WTC buildings made before that year might have contained PCBs. They have been used as lubricants and coolants in capacitors, transformers, and other equipment.

2. The general public can get PCBs into their body from eating fish from contaminated rivers and lakes, meat, and diary products, breathing PCB-contaminated air, and drinking PCB-contaminated water. Low levels of PCBs have been found in the general public.

3. To get sick from PCBs, you have to be exposed to very high levels in a short period of time (for example, a large chemical spill). The health problems from this high-level exposure include a very severe form of pimples (acne) on the face and upper chest and changes in liver function.

   Animals fed PCBs have had nervous system effects, changes in liver, kidney, thyroid glands, and immune function. Most of the effects on animals occurred after they ate large amounts of PCBs for short periods or smaller amounts for several weeks or months.

   The amount of PCBs that caused health effects in animals is far greater than the levels of PCBs found in the environment or in people. People in one area of Michigan were exposed to high levels of PCBs, but so far have shown no evidence of cancer.

4. EPA has monitored for PCBs in the air since Sept. 23, 2001, in and around lower Manhattan. To date, all measurements of PCBs in air have been below the screening level.

   Screening levels are set well below exposure levels shown to cause health effects. Screening levels are meant to trigger further monitoring to assess trends in air quality.

5. On the basis of levels found in the air and water around lower Manhattan, we do not expect residents in the area to have short-term or long-term problems from PCB exposure. EPA continues to monitor PCBs in the air.

This is one of a series of fact sheets produced by the New York City Department of Health (NYC DOH) to keep NYC residents informed about environmental concerns associated with the World Trade Center (WTC) disaster. You can find more information on our Web site: http://www.nyc.gov/html/doh/html/alerts/911.html

Introduction to Polychlorinated Biphenyls (PCBs)

Polychlorinated Biphenyls (PCBs) are a mixture of individual chemicals that are no longer produced in the United States. They have been used as coolants and lubricants in transformers, capacitors, and other electrical equipment because they are good insulators. The manufacture of PCBs was stopped in the United States in 1977 because of evidence that they build up in the environment and can cause harmful health problems. Products made before 1977 that may contain PCBs include old fluorescent lighting fixtures, electrical devices containing PCB capacitors, and hydraulic oils.

Due to the fires burning at the World Trade Center (WTC), PCBs might have been released into the air from the combustion of electrical equipment used in the construction of the WTC. Sources of exposure to PCBs around the World Trade Center are most likely due to old fluorescent lighting fixtures, electrical devices containing PCB capacitors, and old hydraulic oils burning at the site.

Routes of Exposure to PCBs

PCBs still can be released to the air, water, and soil from hazardous waste sites, illegal or improper disposal of industrial wastes and consumer products, leaks from old electrical transformers containing PCBs; and burning of some wastes in incinerators. They do not break down easily and are still found in the environment today. PCB concentrations build up in the food chain resulting in measurable levels in fish and animals. One of the main exposures to PCBs is eating fish (especially sportfish caught in contaminated lakes or rivers), meat, and dairy products. Children then can be exposed to PCBs through their mother's breast milk. Exposure also can occur from breathing air near hazardous waste sites and drinking contaminated well water. The route of exposure of concern from the WTC disaster site is air.

Health Effects of PCBs

The effects of exposure to any hazardous substance, including PCBs, depends on how much the individual is exposed to, how long they are exposed, and how many times they are exposed. Personal traits and habits such as smoking, past chemical exposure, current health status, and taking certain drugs and medicines also affect an individual's health risks.

Health risks must be further broken down into short-term effects from acute exposures to long-term effects from chronic exposure. Exposure to high levels of PCBs for short periods of time (from chemical spills) can cause changes in liver function and skin conditions such as acne and rashes. Levels of airborne PCBs around the WTC have not been high enough to cause these kinds of health effects.

After several years of exposure to PCBs, long-term health effects can include liver damage, neurological effects, reproductive effects, and changes in the immune system. EPA has also classified PCBs as probable human carcinogens. Long-term health effects are not likely to occur among the general public because the levels of PCBs found in the air are very low. Levels of PCBs around the WTC have been well below the guidelines for human exposure.

Standards for Exposure to PCBs

The Environmental Protection Agency (EPA) developed guidelines of exposure to PCBs in the air for the general public that are called "screening levels" using the EPA Hazard Evaluation Handbook. The EPA screening level is set well below exposure levels shown to cause cancer in animals, as well as those associated with any other health effects. The screening levels for residential exposure to PCBs were developed by the EPA to protect residents from a 1 in 10,000 chance of developing cancer as a result of 24-hour continuous exposure to high levels of the chemical over the course of a year. The standard screening level is a value below which little or no disease in humans is expected to occur. EPA screening levels for PCBs are based on continuous 24-hour exposure for a year to an average concentration of 730 nanograms per cubic meter of air (ng/m3).

PCB Results from Routine Air Monitoring around the World Trade Center

EPA has 10 air monitoring sites for PCBs in and around lower Manhattan and collects two samples per week from each site. These sites were set up on September 23, 2001, in response to the WTC attack. To date, all measurements of airborne PCBs at sites surrounding the WTC work zone have been below the EPA screening level of 730 ng/m3. Because measured PCB levels to date have been significantly lower, EPA does not expect increased risks of health problems as a result of PCBs from the WTC site.

Drinking water for lower Manhattan is from reservoirs in upstate New York. The city Department of Environmental Protection is monitoring water quality throughout the distribution system in the city. Over 900 sampling stations are located in the five boroughs. Water samples

are analyzed for contaminants at the city laboratories. Drinking water quality throughout the period following the WTC attack has not been altered from its usual quality and meets all federal and state health-related standards. In addition, EPA has also tested for PCBs in drinking water at 13 lower Manhattan sites. All results for PCBs in drinking water were below the federal drinking water maximum contaminant levels. PCBs have not been found to enter the drinking water from the WTC attack.

EPA tested four lower Manhattan sites for PCBs in ambient water (nondrinking water) following two different rain events. Testing in ambient water shows levels of PCBs similar to those found before the September 11 attack.

Medical Tests To Determine Whether Exposure to PCBs Has Occurred

Results of routine air monitoring to date have not indicated that testing for PCBs is necessary for the general public. Most people normally have low levels of PCBs in their body because nearly everyone has been environmentally exposed to PCBs. Tests exist to measure levels of PCBs in blood, body fat, and breast milk, but these are not routinely conducted. The tests can show if your PCB levels are elevated, which would indicate past exposure to above-normal levels of PCBs, but cannot determine when or how long you were exposed or whether you will develop health effects.

Steps To Minimize Exposure to PCBs

On the basis of results to date, there is no evidence that there is a need for the general public to take additional steps to minimize their exposure to PCBs. Workers at the WTC site are required to follow protective guidelines while at work. WTC workers ideally should shower and change their clothing before leaving work. If that is not possible, these workers should change and shower as soon as they enter the home. This will protect against not only PCBs but other contaminants in the dust. Work clothes should be kept separate from other clothes and laundered separately.

If residents of lower Manhattan want to take extra precautionary measures to minimize exposure to contaminants **in general**, they should follow the steps to reduce dust in the home. These steps include: removing shoes when coming inside, frequent hand washing, and washing pets' paws after walking outside.

The best way to remove dust is to use a wet rag or wet mop. Sweeping with a dry broom is not recommended because it can make dust airborne again. Because the dust particles are so small, standard vacuuming is not an efficient way to remove the dust. High efficiency, or "HEPA" vacuums, which are now widely available in stores, should be used to remove dust.

Staying Informed

It is often difficult to know how to balance the desire to minimize exposure to environmental conditions with wanting everything to be as normal as possible. The NY DOH hopes that the information in this fact sheet will help the lower Manhattan community to make informed decisions about their own environmental exposures. Making appropriate decisions depends on having good and timely information. The NYC Department of Health encourages everyone to:

1. Monitor air quality reports. To do so, consult the NYC DOH fact sheet, "Environmental Health Questions Following the World Trade Center Disaster" and periodically visit the Web site www.epa.gov/enviro/nyc/.

2. Look for and review updates from public agencies about environmental conditions in lower Manhattan;

3. Work with your building owners and fellow tenants and occupants to achieve the healthiest possible conditions.

Other Resources To Learn More About PCBs

http://www.atsdr.cdc.gov/toxprofiles/phs17.html**Environmental Protection Agency (EPA)**
EPA: http://www.epa.gov/enviro/nyc/pcb/
PCB Home Page at EPA: http://www.epa.gov/opptintr/pcb/

National Institute for Occupational Safety and Health (NIOSH)
NIOSH: http://www.cdc.gov/niosh/

Agency for Toxic Substances and Disease Registry (ATSDR)
ATSDR: http://www.atsdr.cdc.gov/toxprofiles/phs17.html

New York City Agencies
NYC Department of Environmental Protection: http://www.nyc.gov/html/dep/home.html
New York City Department of Health: http://www.nyc.gov/html/doh/html/alerts/911.html

MESSAGES FOR BENZENE

1. Benzene has a sweet odor and it evaporates quickly in air. It is commonly found in urban areas like New York City in air with tobacco smoke, near automobile service stations, and exhaust from motor vehicles. Tobacco smoke is a major source of benzene. Benzene levels in urban areas like New York City can fluctuate widely during the day. Increases in outdoor air levels are primarily due to emissions from increased motor vehicle activity such as rush-hour traffic.

Benzene was produced from the burning of plastics and oil/gas from the pile at the WTC site.

2. Significant health problems occur when people breathe high levels of benzene for long periods of time. A specific type of leukemia or a special type of anemia can occur from repeated high benzene exposure over a long period of time. A short exposure to benzene can irritate the eyes, skin, nose and throat. Benzene at higher levels can cause dizziness, headache, vomiting, and lightheadedness.

3. Benzene test results on the (former) pile at the WTC site were elevated because of the burning debris. The pile at the WTC site had much higher levels of benzene than the surrounding streets/neighborhoods. Therefore, workers near the pile were at highest risk for benzene exposure.

Benzene evaporates quickly in the air. Levels were highest near the pile but air quality greatly improved as one moved away from the pile to the surrounding streets and neighborhoods. Burning at the WTC has contributed to the short-term symptoms of eye, nose, and throat irritation that have been reported in workers and residents in the WTC neighborhood.

4. The time residents in lower Manhattan might have been exposed to benzene was relatively short, and therefore the long-term health effects from benzene exposure are less likely.

Introduction

This is one of a series of fact sheets produced by the New York City Department of Health to keep NYC residents informed about the health risks associated with the environmental changes experienced during the months following the WTC disaster. You can find more information on our Web site: http://cityweb.nycnet/html/doh/html/alerts/911.html.

Benzene

Benzene is a colorless liquid with a sweet odor that evaporates quickly into the air and dissolves slightly in water. It is highly flammable and is formed from both natural processes and human activities. Benzene is in a class of chemicals called volatile organic compounds (VOCs).

Outdoor air normally contains low levels of benzene from tobacco smoke, automobile service stations, exhaust from motor vehicles, and industrial emissions such as the burning of oil and gas. Tobacco smoke is a major source of benzene.

Sources and Routes of Exposure

Benzene is widely used in the United States. It ranks in the top 20 chemicals for production volume. Industries use benzene to make other chemicals such as plastics, resins, and nylon and synthetic fibers. Benzene is also used to make some types of rubbers, lubricants, dyes, detergents, drugs, and pesticides. Natural sources of benzene include volcanoes and forest fires. The primary release of benzene into the environment comes from its use as a major industrial chemical and from the use of oil and gasoline.

People can be exposed to benzene in a variety of ways including:

- breathing air from motor vehicle traffic emissions,
- breathing air at filling stations,
- breathing air around manufacturing plants that produce or use benzene,
- breathing tobacco smoke,
- handling products containing benzene such as gasoline,
- working in a job where benzene is used,
- ingesting (eating and drinking) contaminated food or water.

Most people come into contact from benzene by breathing it. It accounts for more than 99% of the total daily intake of benzene. Contact with skin accounts for a minor portion of total exposure for the general population. The largest amount of exposure to benzene comes from workplaces where benzene is made or used. Among people, smoking is the largest source of background exposure to benzene.

Benzene levels in urban areas like New York City can fluctuate widely during the day. Increases in outdoor air levels are primarily due to emissions from increased motor vehicle activity such as rush hour traffic. In response to these urban area levels, EPA has adopted several programs to reduce benzene emissions from large urban sources such as motor vehicles. More information on these programs can be found at www.epa.gov/otaq.

3. **Health Effects**

The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

Breathing high levels of benzene can cause drowsiness, dizziness, rapid heart rate, headaches, tremors, confusion, and unconsciousness while very high levels of benzene can result in death.

Eating or drinking foods containing high levels of benzene can cause vomiting, irritation of the stomach, dizziness, sleepiness, convulsions, rapid heart rate, and death.

The major effect of benzene from long-term (365 days or longer) exposure/contact is on the blood. Benzene causes harmful effects on the bone marrow and can cause a decrease in red blood cells leading to anemia. It can also cause excessive bleeding and can affect the immune system, increasing the chance for infection. Some women who breathed high levels of benzene for many months had irregular menstrual periods and a decrease in the size of their ovaries. It is not known whether benzene exposure affects the developing fetus in pregnant women or fertility in men. Studies of pregnant animals regularly exposed to high levels of benzene have shown low birth weights, delayed bone formation, and bone marrow damage.

The Department of Health and Human Services (HHS) has determined that benzene is a known human carcinogen. Long-term exposure to high levels of benzene in the air can cause leukemia---a cancer of the blood-forming organs.

4. **Results collected to date in routine monitoring**

Measurements of benzene have been conducted near the WTC pile, streets, and surrounding neighborhoods in lower Manhattan. These measurements contain benzene from the normal background emissions from city traffic as well as emissions from the WTC site. Nearly all of these measurements were "grab" samples, lasting but a few minutes; they are intended to quickly compare levels at the pile on the WTC site with those found in the surrounding streets.

To protect workers at the site, EPA attempted to identify the highest concentration levels of benzene by taking grab samples where smoke plumes were sighted on the pile at the WTC site. Some of the benzene levels on the pile at the WTC site were high because of the burning debris. The pile at the WTC site had much higher levels of benzene than the surrounding streets/neighborhoods. Therefore, workers were at highest risk for benzene exposure, since the benzene levels around the streets near the WTC were much lower. EPA urged workers to wear respirators and other protective gear, which the agency and others have provided. Used properly, respirators could protect workers from exposure to benzene and other contaminants at the levels found.

Benzene evaporates quickly in the air. Levels were highest near the pile but air quality was greatly improved away from the pile in the surrounding streets and neighborhoods. In some areas of lower Manhattan, the levels of benzene were above background; however, with wind changes and the quick dissipation time of benzene, the levels of benzene dropped quickly. Therefore, the time residents might have been exposed to benzene was relatively short, and, therefore, long-term health effects from benzene exposure are less likely. The burning of the WTC, however, certainly contributed to the symptoms of eye, nose, and throat irritation that have been reported in workers and residents in the WTC neighborhood.

Full-day air samples also were taken at eight sites, mainly along the outer edge of the pile at the WTC site. These measurements are comparable to levels seen prior to Sept. 11 in New York City and confirm the rapid dissipation of benzene away from the debris pile. These full-day air samples are all below EPA's screening level, which was set to be protective against significantly increased risks of cancer and other adverse health effects.

Screening levels, benchmarks, EPA standards for exposure

The screening level set by the Environmental Protection Agency (EPA) does not mean that illness will occur above those levels; it means that further monitoring and "closer attention" is needed. EPA sets screening levels to be protective of health. The EPA benzene screening level requires benzene in air not to exceed 20 parts per billion for 1 year. This assumes a continuous exposure of 1 year.

In water, EPA has set the maximum permissible level of benzene in drinking water at 0.005 milligrams per liter (0.005 mg/L). New York City drinking water has not been affected by the WTC disaster. The drinking water meets current EPA standards.

The Occupational Safety and Health Administration (OSHA) set a permissible exposure limit of 1 part benzene per million parts of air (1 ppm) in the workplace during an 8-hour workday, 40-hour workweek. Therefore, OSHA standards were used for workers on the pile at the WTC site.

Information about availability (or lack of) medical detection/screening tests

Several tests can show if exposure to benzene has occurred. There is a test for measuring benzene in the breath, but the test must be done shortly after exposure. Benzene also can be measured in the blood; however, since benzene disappears rapidly from the blood, measurements are accurate only for recent exposures. In the body, benzene is converted to products called metabolites. Certain metabolites can be measured in the urine. However, this test must be done shortly after exposure and is not a reliable indicator of how much benzene was involved, since the metabolites might be present in urine from other sources.

How to minimize exposure

- When smoke levels are high and irritating outdoors, limit time outdoors.
- Avoid physical exertion, indoors or outdoors, when smoke levels are high.
- If you have symptoms of heart or lung disease, including shortness of breath, chest tightness, chest pain, palpitations or unusual fatigue, contact a physician.
- Persons with asthma, bronchitis, or other lung diseases, or cardiovascular disease, should make sure adequate medication is on hand. In addition, people with asthma should follow their asthma management plan.

Ongoing efforts of city, state, and federal agencies

While work continues at the site, the NYC Health Department, the EPA, and the Department of Environmental Protection will continue to monitor air and water quality in the area around ground zero.

While some areas might experience slightly elevated levels of benzene from increased vehicle activity and idling trucks, the levels are not expected to cause significant long-term health problems.

There also are other resources to learn more about benzene:

EPA results of routine air monitoring for benzene: http://www.epa.gov/enviro/nyc/benzene/ http://www.epa.gov/enviro/nyc/dioxin/

ATSDR Web Page http://www.atsdr.cdc.gov/toxfaq.html

Appendix C—Agency for Toxic Substances and Disease Registry World Trade Center Response Team Duty Roster for September 14 through October 7, 2001

Agency for Toxic Substances and Disease Registry World Trade Center Response Team Members for September 14–October 7, 2001	
Name	**Division of Health Assessment and Consultation Branch**
Loretta Bush	Community Involvement Branch
CDR Danielle DeVoney, PhD, PE	Exposure Investigation and Consultation Branch
Debra Gable, MS	Superfund Site Assessment Branch
CDR Peter Kowalski, MPH, CIH, CSP	Exposure Investigation and Consultation Branch
Karl Markiewicz, PhD	Federal Facilities Assessment Branch
David Mellard, PhD	Superfund Site Assessment Branch
Susan Moore, MS	Exposure Investigation and Consultation Branch
LCDR Sue Neurath, PhD	Federal Facilities Assessment Branch
CAPT Sven Rodenbeck, ScD, PE, DEE	Superfund Site Assessment Branch
LCDR Clem Welsh, PhD, MPH	Exposure Investigation and Consultation Branch
John Wheeler, PhD	Exposure Investigation and Consultation Branch
Lynn Wilder, MS, CIH	Exposure Investigation and Consultation Branch
RADM Robert C. Williams, PE, DEE	Division Director

Agency for Toxic Substances and Disease Registry World Trade Center Response Team Duty Roster for September 14–October 7, 2001

Throughout this time period, the Division Health Assessment and Consultation Director, RADM Robert C. Williams, PE, DEE, and the Team Leader, CAPT Sven E. Rodenbeck, ScD, PE, DEE, were available (24 hours per day) to provide management guidance to the people on call.

Day and Date	Primary Person On-Call	Secondary Person On-Call
Saturday, September 15, 2001	Susan Moore, MS	CDR Peter Kowalski, MPH, CIH, CSP
Sunday, September 16, 2001	CDR Peter Kowalski, MPH, CIH, CSP	CDR Danielle DeVoney, PhD, PE
Monday, September 17, 2001	CDR Danielle DeVoney, PhD, PE	David Mellard, PhD
Tuesday, September 18, 2001	David Mellard, PhD	Lynn Wilder, MS, CIH
Wednesday, September 19, 2001	Lynn Wilder, MD, CIH	John Wheeler, PhD
Thursday, September 20, 2001	John Wheeler, PhD	LCDR Sue Neurath, PhD
Friday, September 21, 2001	LCDR Sue Neurath, PhD	Karl Markiewicz, PhD
Saturday, September 22, 2001	Karl Markiewicz, PhD	Debra Gable, MS
Sunday, September 23, 2001	Debra Gable, MS	Susan Moore, MS
Monday, September 24, 2001	Susan Moore, MS	CDR Peter Kowalski, MPH, CIH, CSP
Tuesday, September 25, 2001	CDR Peter Kowalski, MPH, CIH, CSP	David Mellard, PhD
Wednesday, September 26, 2001	LCDR Clem Welsh, PhD, MPH	Lynn Wilder, MS, CIH
Thursday, September 27, 2001	John Wheeler, PhD	Lynn Wilder, MS, CIH
Friday, September 28, 2001	CDR Danielle DeVoney, PhD, PE	LCDR Sue Neurath, PhD
Saturday, September 29, 2001	LCDR Sue Neurath, PhD	LCDR Clem Welsh, PhD, MPH
Sunday, September 30, 2001	LCDR Clem Welsh, PhD, MPH	Lynn Wilder, MS, CIH
Monday, October 1, 2001	Karl Markiewicz, PhD	CDR Peter Kowalski, MPH, CIH, CSP
Tuesday, October 2, 2001	CDR Peter Kowalski, MPH, CIH, CSP	John Wheeler, PhD
Wednesday, October 3, 2001	John Wheeler, PhD	Debra Gable, MS
Thursday, October 4, 2001	Debra Gable, MS	LCDR Clem Welsh, PhD, MPH
Friday, October 5, 2001	LCDR Clem Welsh, PhD, MPH	LCDR Sue Neurath, PhD
Saturday, October 6, 2001	LCDR Sue Neurath, PhD	David Mellard, PhD
Sunday, October 7, 2001	David Mellard, PhD	Debra Gable, MS

Appendix D----Agency for Toxic Substances and Disease Registry
World Trade Center Response Team
Proposal of Future Team Members

Agency for Toxic Substances and Disease Registry
World Trade Center Response Team
Proposal of Future Team Members
October 8, 2001

Background

After the attack on the World Trade Center, the Division of Health Assessment and Consultation (DHAC) of the Agency for Toxic Substances and Disease Registry (ATSDR) established a team to evaluate the environmental data being reported to ATSDR. In the beginning, the team was composed of a large number of people so that evening and weekend call duties could be spread over a number people. The current situation at the World Trade Center does not require evening and weekend office coverage. In addition, the initial need for a large number of toxicologists to develop action levels and technical fact sheets is beginning to subside (i.e., work on the appropriate action levels and technical fact sheets is almost completed).

In addition, the current mission of the team has changed. The mission is now focused on supporting the New York City Department of Health and Mental Hygiene in its effort to respond to community concerns related to the World Trade Center. The team will be responsible for helping the New York City Health Department in an environmental exposure investigation (EI), known as The Residential Sampling Plan, evaluate the environmental data reported by the Environmental Protection Agency (EPA), and other sources, evaluate the environmental data from the Residential Sampling EI, and develop the public health message. Therefore, it is appropriate to refocus the composition of the DHAC World Trade Center Team.

Proposal

To accomplish the current mission of the DHAC World Trade Center Team, ATSDR proposes that the team membership be as delineated in the table below.

Agency for Toxic Substances and Disease Registry
World Trade Center Response Team Members
for October 8, 2001–October 4, 2002

Name	Function	Reasoning
CAPT Sven Rodenbeck, ScD, PE, DEE	Lead	Leader of team since the beginning. Familiar with PHS emergency response and DHAC policies and procedures
Loretta Bush	Community Involvement	Current community involvement person assigned
CDR Danielle DeVoney, PhD, PE	Toxicologist	Can also serve as an environmental reviewer
LCDR Sue Neurath, PhD	Data Management	Familiar with data reported to date
Lynn Wilder, MS, CIH	Sampling Expert	Currently developing the Residential Sampling Plan
CAPT Virginia Lee, MD, MPH, MA	GIS Support	Lead division coordinator for GIS support services
Penny Lampe	Support Staff	Coordinate communications of the federal Environmental Assessment Working Group
Ann Walker	Administrative Support	Budget and pay expert
JoAnn Flesner	Travel Assistant	Coordinate travel arrangements for staff deployed to New York City
RADM Robert C. Williams, PE, DEE	Management	Co-Chair of federal Environmental Assessment Working Group

Appendix E – Examples of Fact Sheets and Technical Briefing Papers Provided to the New York City Department of Health and Mental Hygiene and the Agency for Toxic Substances and Disease Registry Technical Staff Deployed to the New York City Department of Health and Mental Hygiene

ASBESTOS FACT SHEET

In an effort to address the public's concerns about asbestos, the New York City Department of Health developed this fact sheet in collaboration with the New York State Department of Health, the New York State Department of Environmental Conservation, and the Environmental Assessment Group, which includes the Agency for Toxic Substances and Disease Registry, the Centers for Disease Control and Prevention, the Environmental Protection Agency (EPA), and the Occupational Safety and Health Administration (OSHA).

What is asbestos?

Asbestos is a group of naturally occurring fibrous minerals mined for their insulation, friction, and fire-resistant properties. These minerals were used in over 3,000 different products including brake linings, asbestos cement pipe, building materials, and insulation. Most asbestos-containing products have now been replaced by less toxic materials. However, due to the extensive use of asbestos in the past, particularly in brake linings and building products, asbestos fibers are still present in the soil, air, and indoor environments. Low levels of asbestos that are not likely to be harmful to your health can be detected in almost any air or soil sample.

Are levels of asbestos in the air of health concern?

The World Trade Center (WTC), built before the 1970s, was constructed using some asbestos-containing materials (ACM). City, state, and federal agencies have been collecting dust, debris, and air samples since the WTC collapse to determine if asbestos levels are a concern for public health.

Asbestos was found in dust and debris samples taken from the disaster site. Levels of asbestos greater than what would be considered normal (background) for New York City have been detected in the air at many locations in lower Manhattan, but these asbestos levels to date are below levels of health concern. Health officials are continuing to monitor asbestos to determine if concern about long-term exposure is warranted.

What are the health effects of asbestos?

Most of the information on the health effects of asbestos comes from studies of people who were exposed in the past to high levels of asbestos fibers in confined settings such as air in a workplace. Workers who breathe in asbestos for long periods of time may develop a slow buildup of scar tissue in the lungs that can lead to shortness of breath and coughing—a disease called asbestosis. The disease is usually not a concern to people exposed to low levels of asbestos in the environment. Asbestos workers also have an increased risk of getting cancer of the lung and mesothelioma (cancer of the membrane that surrounds the lung and other internal organs). These diseases do not develop immediately, but might only show up many years after

exposure. The risk of lung disease from exposure to asbestos in air depends on a large number of factors including whether or not a person smokes, the length of the asbestos fibers, and the length of time a person is exposed. Most (but not all) studies suggest that long asbestos fibers (e.g., greater than 5 microns in length) are more likely to cause asbestos-related diseases, but the role of short fibers (e.g., less than 2.5 microns, or about 1/10,000th of an inch in length) in causing asbestos-related disease is not as well understood. Exposures of the magnitude and duration found in the workplace are not usually encountered by the general public in everyday life where levels of asbestos fibers in the air are much lower. Short-term exposure to asbestos might also increase the risk of developing lung cancer or mesothelioma, but the risk is probably low because the exposure is not as high and as long as the asbestos exposures typically associated with these diseases (i.e., workplace exposure).

What are the federal guidelines regarding asbestos?

The Occupational Safety and Health Administration (OSHA) requires workers' exposure be kept below 0.1 fibers per cubic centimeter of air over the work shift, as measured using a light microscope. Called a permissible exposure limit (PEL), this regulation does not apply to the general public.

The Environmental Protection Agency (EPA) has established criteria for allowing the re-occupancy of schools after asbestos abatement (e.g., asbestos removal) work. The levels of airborne asbestos in schools must be (1) less than 0.022 asbestos fibers per cubic centimeter of air, measured using a special electron microscope, and (2) equal to or less than asbestos levels in outdoor air. EPA considers this criterion to be a safe level of exposure for sensitive groups, i.e., schoolchildren over years of exposure.

In general, it is not possible to directly compare fiber levels measured by the OSHA method to the fiber levels measured by the EPA school reentry method because of the differences in the standard light and electron microscopes.

The city of New York has adopted the EPA school clearance criteria for public buildings.

For additional information, please visit the New York City Department of Health (NYCDOH) Web site at: http://www/nyc.gov/health ***or the Environmental Protection Agency (EPA) Web site at: http://www.epa.gov/asbestos/index.htm***

Latest Revision - 10/18/01

Residential Sampling Fact Sheet

Purpose of this fact sheet

The following information is provided to help people understand what steps have been taken and/or are being proposed regarding environmental sampling in residential areas following the collapse of the World Trade Center (WTC).

What sampling has been done?

To date, environmental sampling efforts have focused on rescue/recovery areas (occupational); some sampling of commercial building to ensure office worker safety; schools to ensure the safety of children; and ambient air sampling for asbestos in many residential/commercial areas.

Why are we proposing environmental sampling in residential areas?

Residents of lower Manhattan have reported eye, nose, and throat irritation. Airborne compounds known to cause acute health effects include smoke, fiberglass, and inhalable dust (e.g., cement and gypsum), also collectively known as particulate matter. Residents also are concerned about whether compounds might be present that might result in chronic health problems, including respirable silica and asbestos. This sampling will characterize indoor and outdoor air and settled dust that remains in lower Manhattan.

What will the samples be analyzed for?

Samples for **indoor and outdoor settled dust** will be analyzed for

- pH
- asbestos
- crystalline silica
- fiberglass
- gypsum
- mica
- calcite

Samples for **indoor and outdoor air** will be analyzed for

- asbestos
- respirable crystalline silica
- particles by size, and each size range will be tested for asbestos, crystalline silica, fiberglass, gypsum, mica, and calcite.

The New York City Department of Health developed this fact sheet in collaboration with the New York State Department of Health, New York State Department of Environmental

Conservation, and the Environmental Assessment Group, which includes the Agency for Toxic Substances and Disease Registry, Centers for Disease Control and Prevention, Environmental Protection Agency, and Occupational Safety and Health Administration.

10/18/01
3:20 p.m.
4th revised version

AIR QUALITY: PARTICULATE

NOTE: This document was designed to assist public health officials in communicating specific air quality issues to the general public.

Air Quality

The Agency for Toxic Substances and Disease Registry (ATSDR), Centers for Disease Control and Prevention (CDC), Environmental Protection Agency (EPA) and Occupational Safety and Health Administration (OSHA) Environmental Assessment Workgroup is recommending that people in the affected area make an effort to reduce their exposure to air contaminants due to the air quality issues in lower Manhattan resulting from smoke, fire, and dust created by the collapse of the WTC and the on-going response. People who have respiratory problems, such as asthma, emphysema, chronic pulmonary disease (COPD), and bronchitis, should pay attention to their breathing and exposure to smoke and airborne substances including particulate matter. People should consult with their physician immediately if health problems should develop.

Health complaints from the area have been primarily irritant and respiratory in nature (such as coughing, burning throat, irritated eyes, wheezing, difficulty in breathing, and shortness of breath). Airborne compounds known to cause acute health effects include particulate matter (such as TSP, PM_{10}, and $PM_{2.5}$), fiberglass, and inhalable dusts (cement and gypsum). Other compounds that might be present and might result in chronic health issues include respirable silica and asbestos. Efforts to measure air quality are focusing on all these compounds.

Particulate Matter

The term "particulate matter" (PM) includes both solid particles and liquid droplets found in air. Many manmade and natural sources emit PM directly or emit other pollutants that react in the air to form PM. These solid and liquid particles come in a wide range of sizes. Particles less than 10 micrometers in aerodynamic diameter tend to pose the greatest health concern because they can bypass the nose and throat and be deposited in the lungs. Particles less than 2.5 micrometers in diameter are referred to as "fine" particles. Sources of fine particles include all types of combustion (motor vehicles, power plants, wood burning, building fires, etc.) and some industrial processes. Particles with diameters between 2.5 and 10 micrometers are referred to as "coarse." Sources of coarse particles include crushing and grinding operations, and dust from paved and unpaved roads.

To address public health issues associated with PM in air, a characterization of airborne particulate is necessary. Currently, that characterization is incomplete. Therefore, until adequate characterization data (e.g., bulk dust and airborne particulate) is collected, it is essential that air-sampling results include total suspended particulate, PM_{10}, and $PM_{2.5}$. For example, levels of PM_{10} and $PM_{2.5}$ might be below their respective comparison values while health complaints that might be attributed to TSP exposure (e.g., coughing, wheezing, etc.) are being reported.

The total particulate matter in the atmosphere is known as total suspended particulate (TSP). This includes all airborne solid and liquid particles, except pure water, ranging in size from approximately 0.005 μm to 100 μm in diameter. Many of the health complaints (irritation of eyes and throat, coughing, and wheezing) from lower Manhattan could be attributed to high levels of TSP.

Air Quality Standards

National Ambient Air Quality Standards (NAAQS) are promulgated by EPA to meet requirements set forth in the Clean Air Act (CAA). The primary NAAQS are set to protect human health with an adequate margin of safety. The following table references EPA standards for PM_{10} and $PM_{2.5}$. For specific public health actions related to specific PM concentrations, please refer to the Health Comparison Guideline Table at the end of this document.

Particulate Matter	24 Hour	Annual Average
PM_{10}	150 ug/m^3	50 ug/m^3
$PM_{2.5}$	65 ug/m^3	15 ug/m^3
TSP (total suspended particulate)	260 ug/m^3	75 ug/m^3

It is possible that PM from the WTC fire and collapse could have entered homes. Additionally, settled dust can be re-suspended in the air during routine activities. Therefore, if you have dust in your home (e.g., on your couch, floors, countertops, etc.) you should pay particular attention to the recommendations regarding tracking, cleaning, and checking the air-conditioning system. Your indoor environment might have been affected by the WTC fire and collapse even if the windows and doors were closed (smaller particles can enter through very small openings and cracks). Additionally, settled dust can be tracked inside from outdoors by people, pets, and other activities.

Recommendations

The Agency for Toxic Substances and Disease Registry (ATSDR), Centers for Disease Control and Prevention (CDC), Environmental Protection Agency (EPA), and Occupational Safety and Health Administration (OSHA) Environmental Assessment Workgroup is providing the following recommendations to protect against air pollution, reduce exposure, and help people make more informed health decisions.

1. We encourage people with respiratory (e.g., asthma) or heart disease, the elderly, and children to limit their exposure to air pollutants in the lower Manhattan area or

temporarily relocate to an unaffected area until environmental sampling can verify an adequate level of air quality.

2. People having symptoms (shortness of breath, wheezing, difficulty taking a full breath, painful breathing or persistent cough), including those who have not been previously diagnosed with respiratory or heart disease, should contact a physician. Be aware that onset of symptoms can appear as much as 24 to 48 hours after exposure.
3. Keep windows closed during hazy days or if dust is on the streets or entrances and/or smoke is in the air.
4. In dusty areas, minimize dust entering the home by leaving shoes outside or implementing a foot washing station for people and pets prior to entering.
5. Thoroughly wetting dusty and sooty areas prior to cleanup will reduce the amount of PM becoming airborne. Wear the appropriate respiratory protection during clean-up activities.
6. Wash plants before moving indoors those that were on balconies, outdoor windowsills, and roofs.
7. Replace or clean dirty air filters and set the air-conditioner to re-circulate if indoor air is relatively dust-free.
8. A regular vacuum cleaner will clean dusty areas, furniture, and carpeting but some of the dust (especially smaller particles) might re-suspend. Alternatively, using a high-efficiency particulate arresting (HEPA) vacuum without a beater bar is a very effective method to clean and minimize resuspension of dust.
9. Clean rooftop and building air-conditioning systems before use and assess ductwork for signs of contamination.

For additional information to protect against air pollution emanating from the World Trade Center area, **please visit the American Lung Association of New York Web site at** http://www.lungusa.org/newyork/.

Health Comparison Guideline Table for Ambient PM*

24-Hour Levels (ug/m^3) $PM_{2.5}$	24-Hour Levels (ug/m^3) PM_{10}	Levels of Health Concern	Cautionary Statements
0-15	0-55	Good	None
>15-40	>55-155	Moderate	None
>40-65	>155-255	Unhealthy for Sensitive Groups	People with respiratory or heart disease, the elderly, and children, should limit prolonged exertion.
>65-150	>255-355	Unhealthy Sensitive groups may experience more serious health effects.	People with respiratory or heart disease, the elderly and children, should avoid prolonged exertion; everyone else should limit prolonged exertion.
>150-250	>355-425	Very Unhealthy Everyone might experience more serious health effects.	People with respiratory or heart disease, the elderly and children, should avoid any outdoor activity; everyone else should avoid prolonged exertion.
>250	>425	Hazardous The entire population could be affected.	Everyone should avoid any outdoor exertion; people with respiratory or heart disease, the elderly and children, should remain indoors.

* Developed from EPA's Air Quality Index: A Guide to Air Quality and Your Health, EPA-454/R-00-005, June 2000, and EPA Guideline for Reporting of Daily Air Quality—Air Quality Index (AQI), EPA-454/R-99-010, July 1999 (at http://www.epa.gov/airnow/publications.html).

** These comparison levels are guidelines to make public health decisions. Detected concentrations of PM above specific guideline levels do not mean that adverse health effects will occur.

Appendix F—The Final (October 11, 2001) Agency for Toxic Substances and Disease Registry, Centers for Disease Control and Prevention, Environmental Protection Agency, and Occupational Safety and Health Administration Environmental Assessment Workgroup Asbestos Action Levels for World Trade Center Response

FINAL (October 11, 2001) Agency for Toxic Substances and Disease Registry, Centers for Disease Control and Prevention, Environmental Protection Agency, Occupational Safety and Health Administration Environmental Assessment Workgroup Asbestos Action Levels for World Trade Center Response

Action Level & Analysis Method	General Public/Recommendations[1]	Supporting Information[2]	Comments
NYC Background[3] PCM/PCMe[4] f/cc (See footnotes 2 and 3)	• No restriction on access to any area.	AHERA standards (40 CFR 763); ATSDR Toxicological Profile for Asbestos; OSHA 29 CFR 1926.1101	• Remediation goal is to achieve background levels. • AHERA guidance for schools requires that when schools are remediated for asbestos, the indoor air levels of asbestos should be similar to local outdoor air levels. • Lowest attainable cancer risk
NYC Background to 0.01 f/cc PCM/PCMe[3]	• No restriction on access to streets and public/ commercial buildings; continue to monitor • Evaluate to determine if long-term access is acceptable; evaluate trends over months. • Identify source • Take action, as practical, to reduce levels to background	AHERA standards (40 CFR 763); ATSDR Toxicological Profile for Asbestos; IRIS; OSHA 29 CFR 1926.1101	• No significant cancer risk for short-term occupancy for residential and school buildings. • AHERA guidance for schools requires that when schools are remediated for asbestos, the indoor air levels of asbestos should be similar to local outdoor air levels
70 structures/mm^2 TEM	• If < than 70 s/mm^2, no restrictions on access to buildings • If > 70 s/mm^2, resample to confirm and analyze field blanks; take action to identify source and reduce levels to < 70 s/mm^2	AHERA standards (40 CFR 763) NYC Clearance standard for buildings	• AHERA standards apply only to schools, and by NYC ordinance to buildings. • Method sensitivity and counting rules should follow Appendix A (Table 1) in AHERA 40 CFR 763; method sensitivity based on number of grids analyzed and air sample volume and must be maintained at 0.005 f/cc.
0.01 - 0.1 f/cc PCM/PCMe[3]	• Continue to monitor; consider the need for additional sampling sites. • If air levels are consistently between 0.01 to 0.1 f/cc, evaluate the need for advisories, the need to limit access, and the need for dust suppression.	Lowest limit set at 1/10 PEL/REL/TLV; AHERA standards (40 CFR 763); ATSDR Toxicological Profile for Asbestos; IRIS; OSHA 29 CFR 1926.1101;	• Long-term exposures might increase cancer risk in the general public. • Unlike workers, the general population, which includes children and sensitive persons, does not receive exposure monitoring and does not participate in annual health screening
> 0.1 f/cc PCM/PCMe[3]	• Evaluate the need to restrict general public access. • Continue to monitor; consider the need for additional sampling sites.	Unacceptable cancer risk following long-term exposure; AHERA standards (40 CFR 763); ATSDR Toxicological Profile for Asbestos; IRIS; OSHA 29 CFR 1926.1101;	General public should not be exposed to levels suspected of adverse health effects upon long-term exposure.

Action Levels (f/cc) for Workers Involved in Emergency Response and Recovery Activities	Disaster Response and Recovery Workers (Follow Applicable OSHA Standards)	Basis	Comments
0.1 PCM only	• Respiratory protection required for workers, based on an 8-hour time weighted average (TWA) of exposure of 0.1 PCM. Longer shift work, i.e., lower levels of exposure	PEL	Value 0.1 f/cc, on the basis of an 8-hour time-weighted average, is the Occupational Safety and Health Administration's (OSHA) permissible exposure; limit for asbestos, as specified in the OSHA Construction Industry Regulation for Asbestos, 29 CFR 1926.1101.
1.0 PCM only	• The maximum allowable level for workers averaged over 30-minute period (OSHA short-term exposure level). • PPE required above 1.0 f/cc PCM.	STEL	Value 1.0 f/cc, measured over a 30-minute period, is the Occupational Safety and Health Administration's (OSHA) short-term exposure limit for asbestos, as specified in the OSHA Construction Industry Regulation for Asbestos, 29 CFR 1926.1101.

1. General public includes adults and children not directly involved in emergency response and recovery activities. 2. Documents and information that were considered in setting the action level. 3. Background levels for NYC are being determined. 4. PCM equivalents (PCMe) are determined using TEM analysis and counting fibers > 0.3 μm in diameter and > 5 μm in length. PCMe should be determined using consistent methods to provide comparable concentrations. If PCM is exceeded, might need to determine PCMe using TEM. Use professional judgment to determine if PCMe is needed by evaluating the frequency and magnitude of exceedance, size of geographic area involved, and trends in data.

Appendix G—World Trade Center Health Effects Screening Criteria for Ambient Air

World Trade Center Health Effects Screening Criteria for Ambient Air

Extensive air quality monitoring data have been collected at and around the World Trade Center (WTC) site since 9/11/01. Table 1 (Screening Criteria) is intended to provide screening values for data evaluation. The list of contaminants in Table 1 represents those chemicals that, because of their frequency/magnitude of detection, and intrinsic toxicity, pose the greatest potential hazard from exposure. Two populations were identified for assessment: response/demolition (i.e., WTC site) workers; and residents living in lower Manhattan (e.g., Battery Park City, Tribeca, and other residential locations close to Ground Zero). Included in the resident category are all other workers located in lower Manhattan with the exception of WTC site workers.

The following paradigm was employed to develop screening values. For each of the two identified receptor populations (i.e., site workers and residents), existing standards were utilized where appropriate. Occupational standards (i.e., OSHA PELs) were used for all site workers conducting response/demolition activities covered by OSHA. Monitoring data obtained from demolition areas were compared to OSHA PELs. (For example, the OSHA PEL of 1 ppm for benzene was used to evaluate benzene air samples taken directly from within the plume on the debris pile). Environmental standards (e.g., NAAQS, AHERA) were utilized to evaluate monitoring data obtained from the site perimeter and beyond where residents or non-AC site workers might be exposed. For example, lead air-monitoring data obtained from perimeter stations outside of the immediate work zone were evaluated against the NAAQS of 1.5 ug/m3.

In cases where appropriate standards do not exist, risk-based screening criteria have been developed for residential (including the non-WTC site workers) receptors. (In the absence of OSHA standards, it is beyond the scope of EPA's mission to develop "occupational" screening values.) The risk assessment paradigm detailed in EPA's "Hazard Evaluation Handbook: A Guide to Removal Actions" (HEH) was employed for this initiative (except where otherwise noted in the table footnotes). That is, for carcinogenic compounds excess lifetime cancer risk was set at E-04 (1-in-10,000) and for noncarcinogenic compounds the hazard quotient (chronic daily intake/RfC) was set at 10. The residential exposure scenario in the HEH was modified for carcinogens from the default of 30 years (upper-bound estimate for residency in one dwelling) to 1 year (to reflect an upper-bound estimate for the length of time a resident might be potentially exposed to AC-related contaminants). For carcinogenic substances, in cases where the screening value based on a noncancer endpoint is more stringent, screening values for both cancer and noncancer endpoints are presented. Screening levels reflect the most current toxicity criteria (slope factors and RfCs) on EPA's Integrated Risk Information System (IRIS).

NOTE: Individual sampling results that exceed screening values should not be interpreted to represent the occurrence of an adverse health effect. Rather, such information indicates the need for careful monitoring and the assessment of longer-term data trends for evaluation against appropriate health criteria. That is, many of the screening levels have been developed to account for continuous 1-year average exposure durations. Because these screening levels assume continuous exposure for an extended duration, the average of the measured concentrations is more appropriate for evaluating risk than an individual measurement. Consequently,

miscellaneous individual values above the screening level might not necessarily be indicative of potential for concern.

Table 1. World Trade Center Screening Criteria		
Contaminant	**Site Worker** [1]	**Resident** [2]
Inorganic		
Asbestos [3]	0.1 f/cc (PCM)	70 S/mm2 (TEM)
Cadmium	5 ug/m3	0.2 ug/m3 [9]
Chromium [4]	100 ug/m3	0.45 ug/m3 [5]
Lead	50 ug/m3	1.5 ug/m3 [7]
Sulfur Dioxide	5 ppm	0.14 ppm [7]
Particulates		
Total	15,000 ug/m3	NA
Respirable	5,000 ug/m3	NA
$PM_{2.5}$	NA	40 ug/m3 [8] 65 ug/m3 [7]
PM_{10}	NA	150 ug/3 [7,8]
Semi -Volatiles		
Dioxin/Furans (TEQ)	NA	0 .162 ng/m3 [5]
PCBs	1,000 ug/m3	0.73 ug/m3 [6] 9 ug/m3 [5]
PAHs [16]	NA	6 ug/m3 [5, 17]
Volatiles		
Acetone	1,000 ppm	1.5 ppm [6]
Benzaldehyde	NA	860 ppm
Benzene	1 ppm	0.02 ppm [9] 0.21 ppm [5]
Benzonitrile	NA	NA

Table 1. World Trade Center Screening Criteria		
Contaminant	**Site Worker** [1]	**Resident** [2]
1,3 Butadiene	1 ppm	0.01 ppm [5, 15]
Chloromethane	100 ppm	0.4 ppm [6]
1,4 Dioxane	100 ppm	0.5 ppm [5]
Ethanol	1,000 ppm	45 ppm [10]
Ethylbenzene	100 ppm	2.5 ppm [6]
Freon 22	1,000 ppm [14]	140 ppm
Propylene	LEL [13]	Simple asphyxiate
Styrene	100 ppm	2.3 ppm [6]
alpha methylstyrene	100 ppm	0.1 ppm [6]
Tetrahydrofuran	200 ppm	0.9 ppm [5]
Toluene	200 ppm	1.1 ppm [6]
Xylenes	100 ppm	1 ppm [11]
Reactive Gases		
Acetaldehyde	200 ppm	0 .05 ppm [6]
Formaldehyde	0.75 ppm	0.04 ppm [12]
Acrolein	0 .1 ppm	0.0001 ppm [6]

Units

f/cc = fibers (>5 um length) per cubic centimeter of air
S/mm2 = structures (>.5 um length) per square millimeter of filter paper
ppm = parts per million in air
ug/m3 = micrograms of contaminant per cubic meter of air
ng/m3 = nanograms of contaminant per cubic meter of air
NA—not applicable

Footnotes

1. "Site Workers" refers to all workers involved in the response/demolition of the World Trade Center. Listed values are OSHA PELs (TWA) unless otherwise noted.

2. "Residents" refers to people living in the vicinity of the World Trade Center as well as all other potentially exposed workers not involved in the response/demolition

3. Resident screening value is based on AHERA methodology that uses TEM, and because of its basis in "background" (vs. a risk basis) includes all asbestos fibers greater than 0.5 microns in length. Worker values are based on PCM (which doesn't distinguish asbestos from other fibers) or, for results above the screening value, TEM to derive a PCM equivalence that includes all asbestos fibers greater than 5 microns in length.

4. Screening values for chromium were based on the most toxic form (hexavalent)

5. EPA—HEH (carcinogen) > 1 year of continuous exposure equating to an excess lifetime cancer risk of 1-in-10,000

6. EPA—HEH (noncarcinogen) > Hazard Quotient (HQ) = 10

7. National Ambient Air Quality Standard (NAAQS)
   - Lead is a 3-month average
   - $PM_{2.5}$ is a 24-hour average
   - Sulfur dioxide is a 24-hour average primary standard

8. Air Quality Index

9. Noncancer effects are based on CAL-EPA toxicity studies.

10. ACGIH TLV

11. ATSDR Inhalation MRL x 10

12. ATSDR acute MRL

13. Lower Explosive Limit (2 - 11%)

14. NIOSH

15. Proposed RfC—HEH (noncarcinogen) > hazard quotient (HQ) = 10
16. Based on benzo(a)pyrene toxicity equivalency factor (TEF)

17. EPA NCEA provisional inhalation slope factor (3.1 E 00 $mg/kg/day^{-1}$)